REMARKS

Applicants respectfully request reconsideration of this application, and reconsideration of the Office Action dated April 26, 2005. Upon entry of this Amendment, claims 1-13 and 16-20 will remain pending in this application. The amendments to the claims are supported by the specification and original claims. See, for example, page 2, Line 21 to page 3, line 10. No new matter is incorporated by this Amendment.

* * * * *

Claims 14 and 18-20 are rejected under 35 U.S.C. § 112, second paragraph, as purportedly indefinite.

Specifically, with respect to claim 14, the Office Action asserts the term "high" is indefinite. Claim 14 has been canceled by this Amendment rendering this part of the rejection moot.

With respect to claims 18-20, the Office Action asserts the terms "MS" and ".5t" are unclear. Applicants respectfully traverse.

Applicants first discuss the term "0.5t." Claim 19 recites, "provided that the maximum thickness of said bearing part is expressed as t". In other words, in claim 19, t is defined as "the maximum thickness of the bearing part." Claim 19 then states, "the quenching is carried out until the temperature at the portion corresponding to a depth of 0.5t or less." Thus, "0.5t" represents ½ the maximum thickness of the bearing part. The specification, at page 7, lines 6 to 15 also teaches what is intended by this terminology. Hence, Applicants submit one of ordinary skill in the art would readily understand what is intended by "0.5t."

Now turning to the term "MS." As described in claim 18 and in the specification at page 7, lines 15 to 17, the "MS point" refers to the "point at which martensitic transformation starts." Also, Applicants enclose herewith a document obtained from the internet which explains what the terminology "martensitic transformation" means and that

"MS" refers to the point at which martensitic transformation starts. Again, Applicants submit one of ordinary skill in the art would readily understand what is intended by "MS point."

Hence, in view of the above remarks, this rejection has been overcome and its withdrawal is requested.

* * *

Claims 1, 2, 4-6, 8, 9, 10, 12-14, and 17 are rejected under 35 U.S.C. § 102(e) as purportedly anticipated by Folger et al. (U.S. Pat. No. 5,009,523). The Office Action asserts Folger discloses each feature of these claims and thus anticipates the claimed invention. Applicants respectfully traverse.

Independent claim 1 concerns a bearing part having a hole portion opening into a surface thereof and hardened at least at the surface by a heat treatment. The bearing's surface has a hardness of HRC60 or more. Moreover, the residual compressive stress of the surface is made of 30MPa or less in order to obviate failure in a peripheral area of the hole portion during heat treatment. The present invention is able to maintain the recited hardness while still obviating failure of the bearing, such a cracking during heating.

Folger neither teaches nor fairly suggests a bearing having the recited hardness and residual compressive stress. Accordingly, for at least this reason, Folger fails to teach each and every feature of the claimed invention and thus cannot anticipate the claimed invention. Moreover, according to Applicants, the bearing disclosed by Folger would not necessarily have the recited residual compressive stress of 30 MPa or less since such a residual compressive stress is not natural in the technical field of bearing parts.

Applicants submit that in view of the above remarks, this rejection is overcome. Hence, reconsideration and withdrawal of the rejection are respectfully requested.

* * *

Claims 3, 7, 11, 15, 16, and 18-20 are rejected under 35 U.S.C. § 103(a) as purportedly obvious based on Folger et al. in view of the Examiner's Official Notice or, in

the alternative, engineering design choice. Applicants also respectfully traverse this rejection.

The deficiencies of Folger are discussed above. Moreover, neither the Examiner's Official Notice nor "engineering design choice" remedies the deficiencies. Nothing in the art of record teaches nor fairly suggests a bearing having the recited hardness and residual compressive stress. Moreover, there is nothing in the teachings of the art of record which would motivate those of ordinary skill in the art to obtain a bearing having the above recited features. Folger is not even concerned with obviating bearing failure, such a cracks, in a peripheral area of a hole portion of the bearing part which can occur during heating. Accordingly, the teachings of Folger would not suggest to one of ordinary skill in the art to produce a bearing having the recited features.

Applicants submit that in view of the above remarks, this rejection also is overcome. Hence, reconsideration and withdrawal of this rejection are respectfully requested.

* * *

The Office Action also requires restriction between Group I of claims 1-17 and Group II of claims 18-20.

Applicants hereby elect <u>Group I of claims 1-17</u>, for further examination in this application. However this election is made only to be fully responsive and is made with traverse for at least the following reasons.

The MPEP states, "If the search and examination of an entire application can be made without serious burden, the examiner <u>must</u> examine it on the merits, even though it includes claims to independent or distinct inventions." (emphasis added). See MPEP § 803. The first action on the merits dated April 26, 2005 considers all of claims 1-20. Moreover, all of the claims of both of the Groups are included in the rejections contained in the action. Accordingly, since the Examiner of record already has searched and considered the claims of <u>both</u> of the now alleged Groups, there can be no showing of

undue burden on the Examiner. Hence, in compliance with the MPEP, this restriction requirement should be withdrawn and routine prosecution should resume for claims 1-20.

For the above reasons, Applicants respectfully request that this restriction requirement be withdrawn and prosecution of all of claims 1-20 continued.

* * * * *

Applicants respectfully submit that this Amendment and the above remarks obviate all of the outstanding objections and rejections in this case, thereby placing the application in condition for immediate allowance. Allowance of this application is earnestly solicited.

If any fees under 37 C.F.R. §§1.16 or 1.17 are due in connection with this filing, please charge the fees to Deposit Account No. 02-4300; Order No. 033737.029.

If an extension of time under 37 C.F.R. § 1.136 is necessary that is not accounted for in the papers filed herewith, such an extension is requested. The extension fee should be charged to Deposit Account No. 02-4300; Order No. 033737.029.

Respectfully submitted,

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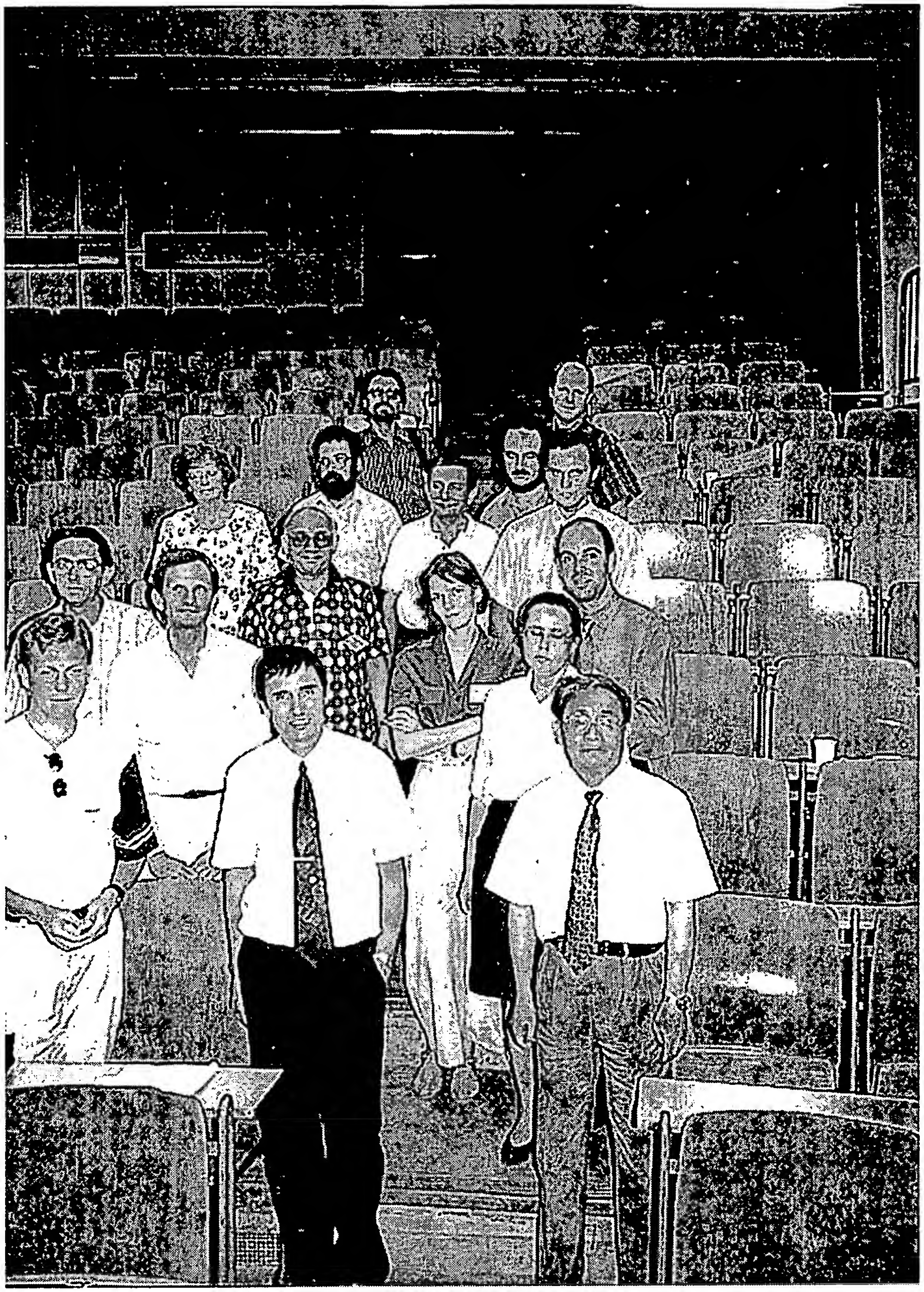
Martensitic Phase Transformations

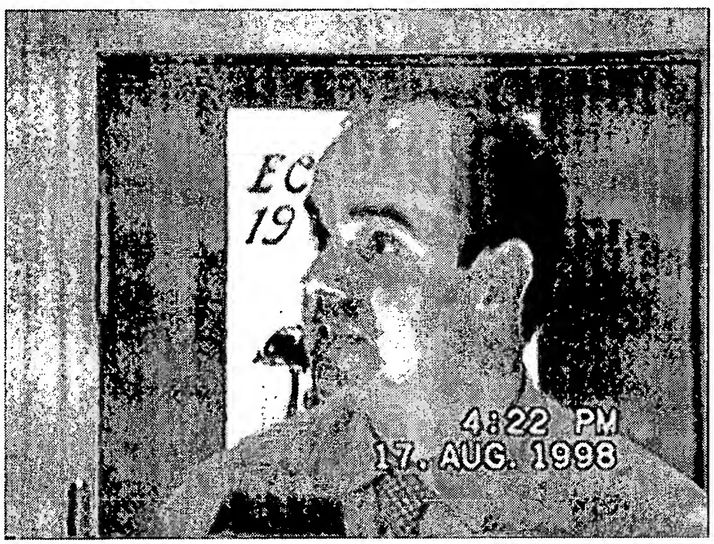
Chair: Henryk Morawiec (Poland), Co-chair: Jaume Pons (Spain)

Nanju Gu, Huifen Peng, Xiaoyan Song, Fuing Yin, Yuguo Wang	**Interaction between Gamma2 - Phase Precipitates and Martensite in Cu-Al-Zn Alloys**	A
J. Pons, E. Cesari	Interaction between γ_2 - Phase Precipitates and Martensite in Cu-Al-Zn Alloys	A
H. Morawiec, T. Goryczka	Structure of the R-phase in NiTi Shape Memory Alloys	A
P. Šittner, V. Novák, V. Studnicka, N. Zárubová	Stress State Dependence of Martensite Formation in Cu-Based Shape Memory Alloys	A
N.I. Taluts, A.V. Dobromyslov	Features of Bainitic Transformation in Zr-Rh Alloys	A
V.A. Andrushchenko, E.N. Dzevin	Effect of Laser Influence on Martensite Transformation into near Surface Layers of Fe-Al-C Alloys	A



The Middle Age Knights used to heat their swords in fire and quench them in cold water; after that, the swords became much harder. This method has long been used in the steel industry. The hardening comes from a characteristic microstructure formed by quenching, which is denoted by the term *martensite* in honour of the German metallographer A. Martens. Initially, the term was ambiguously adopted to denote the microstructure of quenched steels, but, as the nature of this microstructure became better known, the meaning of the word has been gradually clarified and extended to other alloys. The process (a phase transformation) by which the martensite is obtained is a *martensitic transformation* (MT). This is a first order solid-solid phase transition with displacive nature (without atomic diffusion) consisting of a homogeneous lattice deformation leading to the new crystal structure. The interface between the parent phase (austenite) and the product phase (martensite) is constituted by an invariant plane denoted as habit plane (in general, with irrational Miller indices). The transformation proceeds by the movement of the habit plane, which is invariant in the sense that two vectors drawn on it maintain constant their modules and relative orientation when the transformation takes place. Due to the displacive character, the transformation proceeds by small cooperative movements of the atoms, keeping the same chemical composition and atomic order of the parent phase. In addition to a change in the crystal symmetry, the transformation brings about a deformation

(mainly a shear on the habit plane) as well as a volume change. From a crystallographic point of view, the change of crystal structure takes place by a homogeneous lattice deformation, but an additional lattice invariant shear, occurring by slip or by twinning, together with a rigid-body rotation also have to be considered in order to keep invariant the habit plane. From a given orientation of the parent phase, several variants of martensite with different orientations are possible.



J. Pons

The MT can be induced by changing the temperature (on cooling) or by applying an external stress. The transformation temperatures (or stresses), which can cover a wide range from ~ 0 K till ~ 500 - 600 K is mainly dependent on the alloy composition, but other factors like atomic order, internal stresses, lattice defects, ... also influence them. In general, the transformation is reversible, the reverse transformation takes place by heating from the martensitic state or by releasing the stress, but it proceeds at higher temperatures or lower stresses than the direct transformation, thus the transformation cycle exhibits hysteresis. The temperature induced transformation develops a multivariant martensitic microstructure with self-accommodation, *i.e.* the deformation associated with one martensite plate is compensated by the neighbour variant, not giving a net macroscopic shape change. On the contrary, a limited number of variants form by the stress induced transformation, those variants which deform the material in the sense of the applied stress. Two types of martensitic transformations can be distinguished. The *burst-type* transformations, typical of the quenched steels, occur almost isothermally and are characterized by a big volume change and a wide hysteresis (hundreds of K, in some cases they are even irreversible). The *thermoelastic martensitic transformations* have a small volume change and low hysteresis (tens of K), i.e. good reversibility. The deformation accompanying the transformation is almost completely elastically accommodated but, due to this elastic energy, a continuous cooling is needed in order to complete the transformation (the transformation starts at the temperature Ms and finish at Mf <Ms).

The thermoelastic martensitic transformation (TMT) occur, among other alloy systems, in the Au-Cd, In-Tl, Ni-Ti and some Cu-based alloys (Cu-Zn, Cu-Al, Cu-Zn-Al, Cu-Al-Ni, ...). Associated to the TMT, specially to the reverse transformation, these alloys exhibit some non-usual thermomechanical behaviours which are manifested by some shape memory capabilities, from which these alloys are referred to as *shape memory alloys* (SMA). If a piece of SMA initially in parent phase condition is cooled to martensite, nothing occurs macroscopically. From the microscopic point of view, a fine relief on the free surfaces is formed, which is characteristic of the self-accommodating martensite microstructure. If now an external load is applied, the piece is deformed in an apparent plastic way (the deformed shape remains after the load is released). In fact, the deformation takes place not by the movement of dislocations, but by a reorientation of the martensite variants towards those favoured by the external load. If now the piece is heated up till the reverse transformation takes place, the parent phase crystal structure and shape is spontaneously restored. It seems that the material ìremembersî its original shape and spontaneously adopts it when heated through the reverse transformation. This is the *shape memory effect*. If the piece of SMA is loaded in the parent phase condition the martensitic transformation is stress induced, which brings about a large deformation (in case of uniaxial tension, up to 10% elongation in well oriented single crystals). If the applied stress is not too high to produce plastic deformation of the martensite, the induced deformation is completely recovered by the reverse transformation when releasing the external load. So, the material can be largely deformed in an apparently elastic way (up to two orders of magnitude more deformation than the elastic deformation of the standard metals). This property is called *pseudoelasticiy*. The *two-way shape memory effect*, in which the material changes spontaneously its shape also on cooling, can also be induced after a suitable training treatment. Finally, when the material is in martensitic state, it has a *high damping capacity* due to the multivariant microstructure and the ability for variant reorientation. It is worth to note that the memory properties are inherent to the TMT, they are not exhibited by the alloys having burst-type transformation. Many applications of the shape memory properties have been developped, specially for the Ni-Ti, which has the best functionality, and, to a lesser extent, the Cu-based alloys. From one side, the SMA can act as temperature sensors, but for this application they do not offer a great improvement compared to the standard ones. A better utility is to use the SMA as actuators (the movement and force available are used to do some action) and also as connectors for pipes and wires and vibration protection. They have applications in a wide range of fields, including robotics (movement of arms and fingers), medicine (orthodontics, guide wires for catheters, surgery implants like stents, ...) as well as car, aerospace and nuclear industry, among others.

E.N. Dzevin

In the ECM-18, symposium A3, 7 works (6 oral and 1 poster) covering a wide range of topics in this field were presented, starting with a review of the phenomenological crystallographic theories for MT, pointing out their limitations. It is worth to note that, from a crystallographic point of view, the theories describing the MT are phenomenological, a few knowledge exists on the exact movement of the atoms to develop the new phase. In this subject, the Crystallography community can make a fruitful contribution. Other works on the standard SMA, as Ni-Ti and Cu-based alloys, as well as more exotic (less investigated) ones, like Zr-Rh and Fe-Al-C were presented and discussed as well.

Video

J. Pons, Co-Chair (ECM-18 report session A3)